Cache Mapping

1. Direct Mapping
2. Associative Mapping
3. Set- Associative Mapping

Direct Mapping

Main memory size = 128 B = 2^7

Cache memory size = 32 B

Block size = 4 B

No. of words present in a block = 4 = 2^2

No. of blocks present in cache

$$= \frac{\text{cache memory size}}{\text{block size}}$$

$$= \frac{32}{4} = 8 = 2^3$$

No. of blocks present in main memory

$$= \frac{\text{main memory size}}{\text{block size}}$$

$$= \frac{128}{4} = 32$$

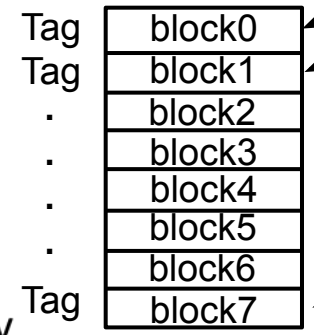
No. of Tags present

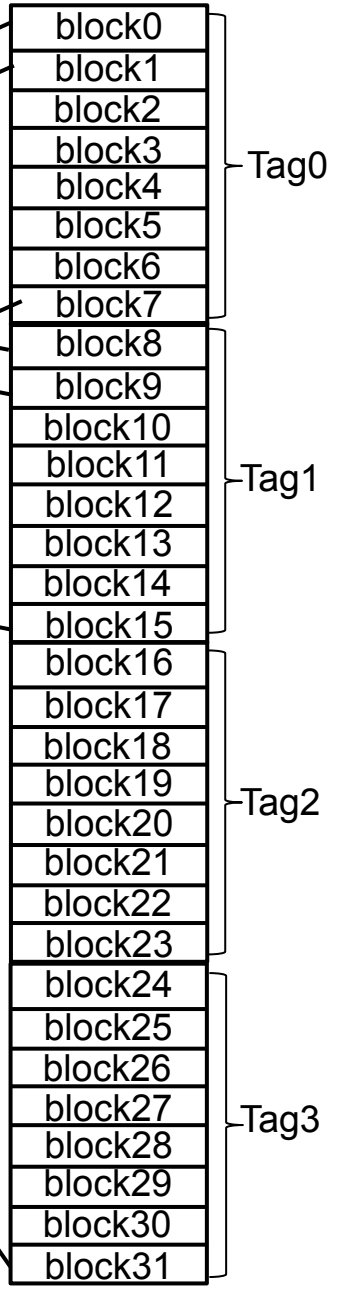
$$= \frac{\text{main memory size}}{\text{cache memory size}}$$

$$= \frac{128}{32} = 4 = 2^2$$

Any block i is mapped with block i mod 8

Mapping function= i mod no. of block present in cache



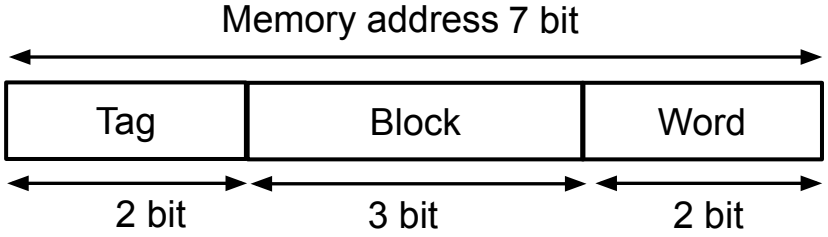


00 011 10

Tag 0 | Block 3 | Word 2

01 111 11

Tag 1 | Block 7 | Word 3



Associative Mapping

Main memory size = 128 B

Cache memory size = 32 B

Block size = 4 B

No. of blocks present in cache

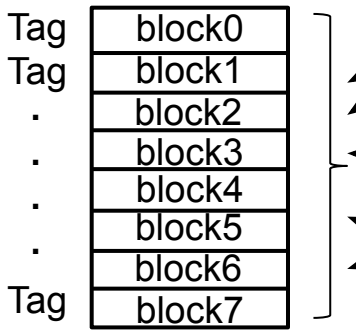
$$= \frac{\text{cache memory size}}{\text{block size}}$$

$$= \frac{32}{4} = 8$$

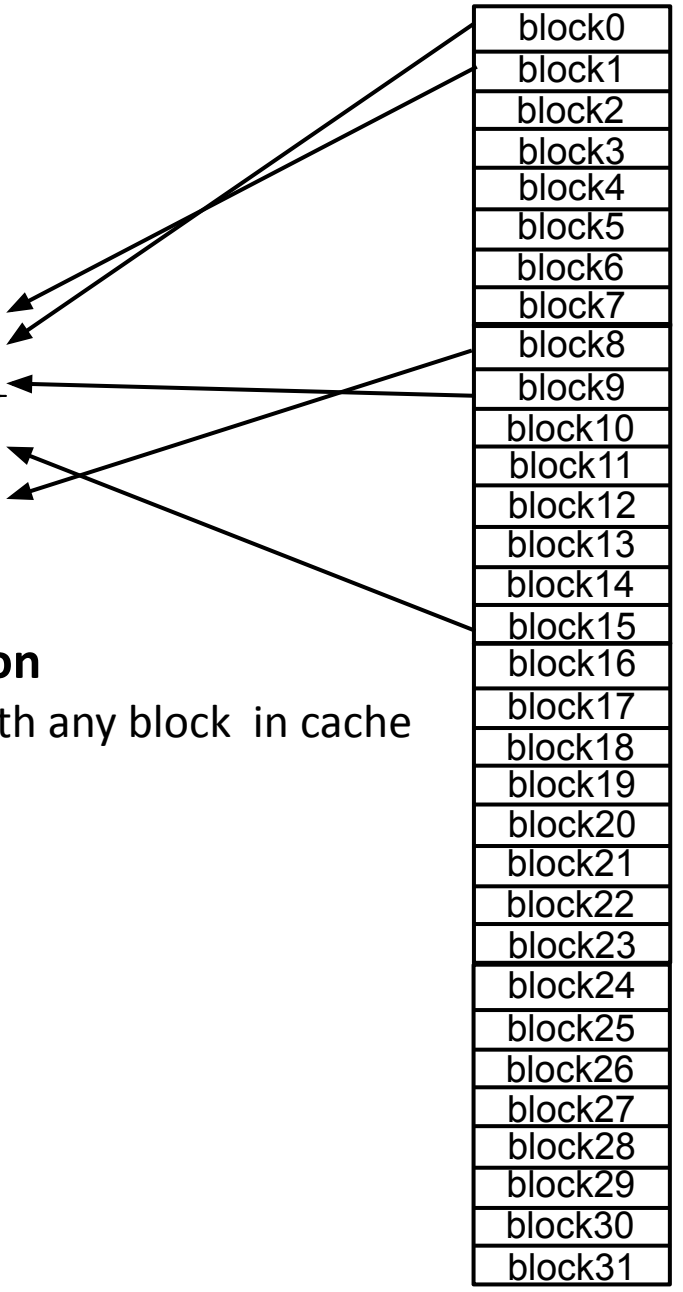
No. of blocks present in main memory

$$= \frac{\text{main memory size}}{\text{block size}}$$

$$= \frac{128}{4} = 32$$



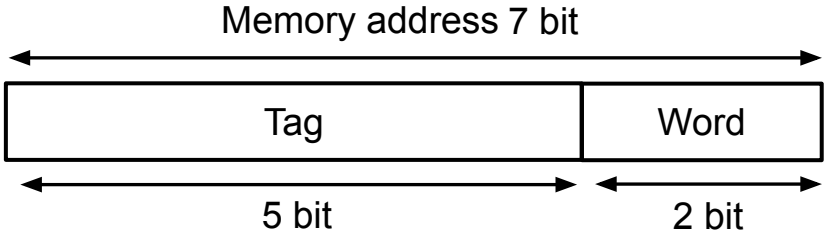
cache



main memory

Mapping function

Any block can be mapped with any block in cache



Set-Associative Mapping

n way Set-Associative mapping
Where $n=2^x$ and x=1,2,3…..m
If x=1
then n=2 and it is 2 way Set-Associative mapping
If x=2
then n=4 and it is 4 way Set-Associative mapping
If x=3
then n=8 and it is 8 way Set-Associative mapping

.
.
.
.

2 way Set-Associative Mapping

Main memory size = 128 B
Cache memory size = 32 B
Block size = 4 B
No. of way =2
No. of block present in cache=8
No. of set present in cache

$$= \frac{\text{No. of blocks present in cache}}{\text{No of way}}$$

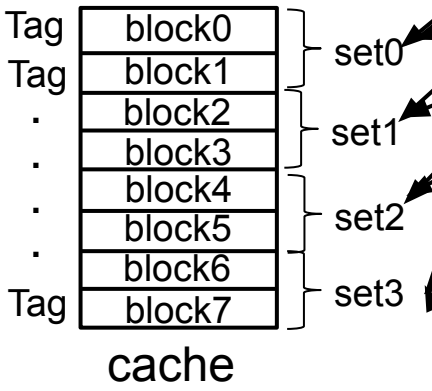
$$= 8/2 = 4 = 2^2$$

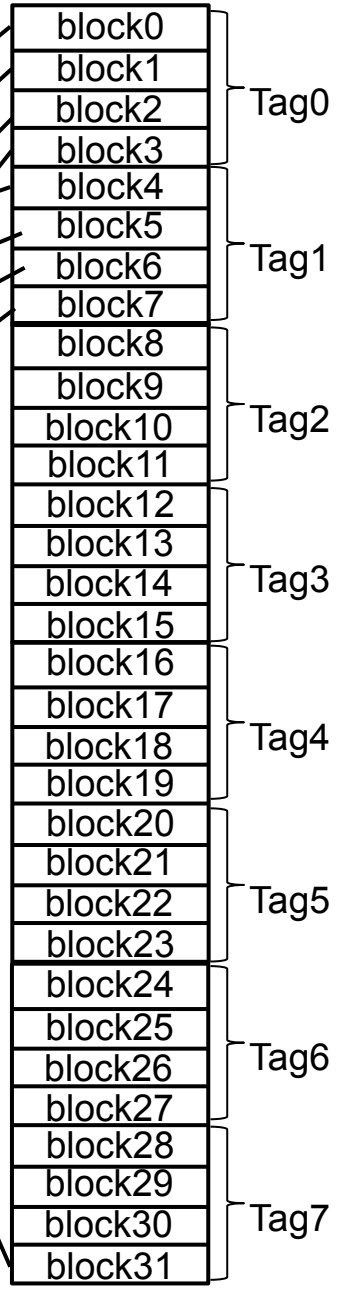
No. of Tags present

$$= \frac{\text{main memory size}}{\frac{\text{cache memory size}}{\text{No of way}}}$$

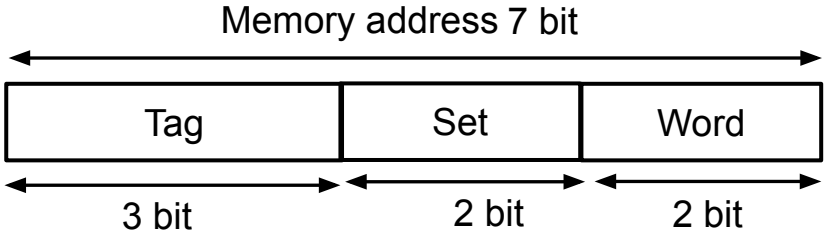
$$= \frac{128 \text{ X } 2}{32}$$

$$= 8 = 2^3$$





Any block i is mapped with block i mod 4
Mapping function= i mod no. of set present in cache



Direct Mapping

Assume a system has 2 KB cache, 64 KB main memory and 16 byte block.

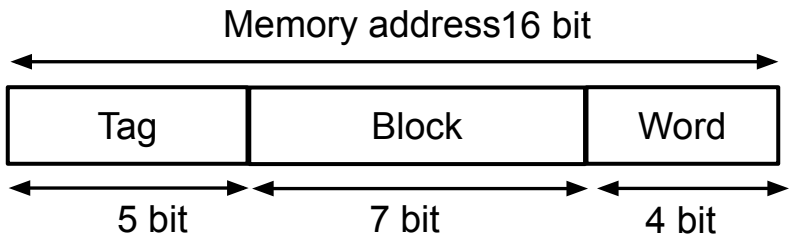
Number of blocks present in cache

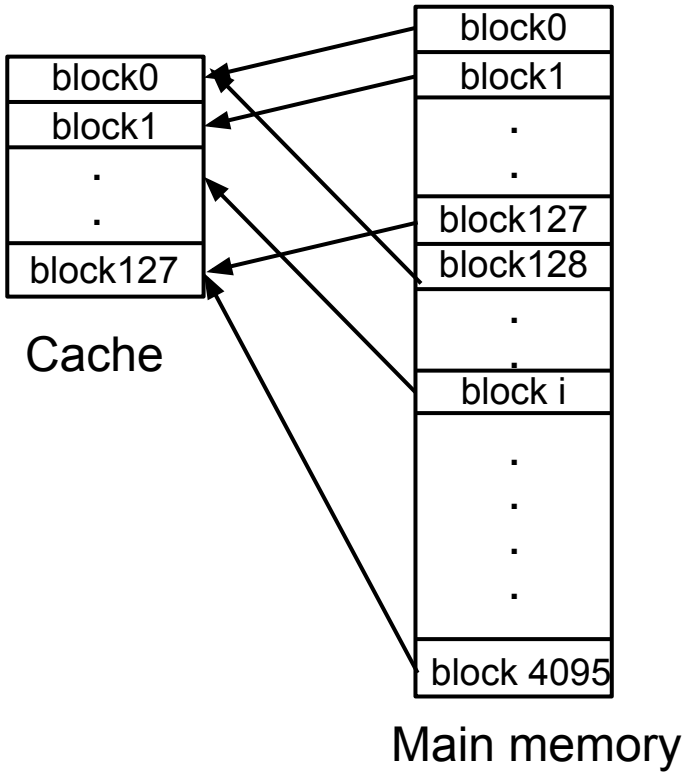
$$= \frac{\text{cache memory size}}{\text{block size}} = \frac{2 \times 2^{10}}{2^4}$$
$$= 2^7 = 128$$

Number of blocks present in main memory

$$= \frac{\text{main memory size}}{\text{block size}}$$
$$= \frac{2^6 \times 2^{10}}{2^4} = 2^{12} = 4096$$

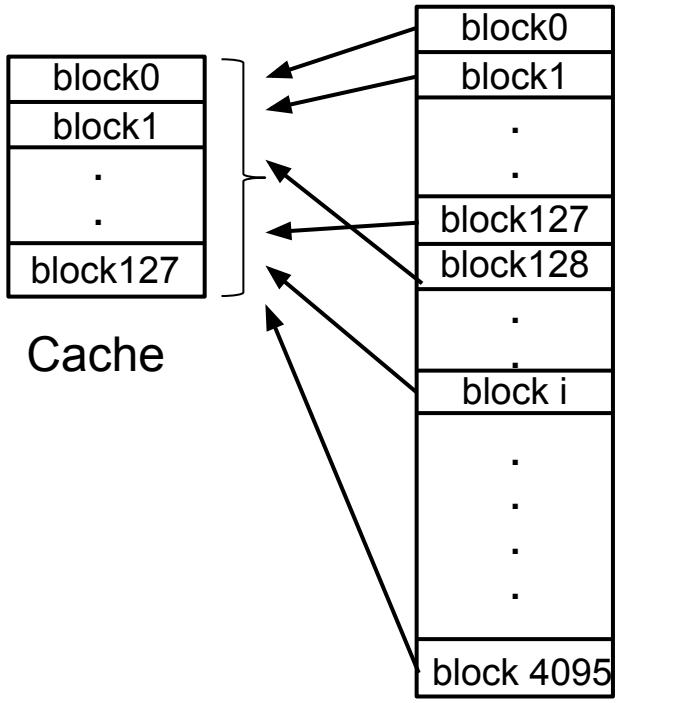
$$\text{Number of tags} = \frac{\text{main memory size}}{\text{cache memory size}}$$
$$= \frac{2^6 \times 2^{10}}{2 \times 2^{10}} = 2^5 = 32$$

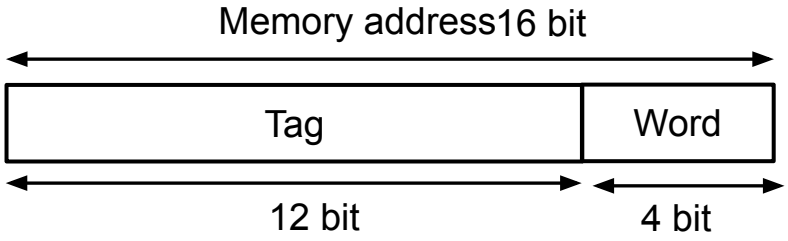




Advantage : Very simple and easy to manage. Search space is minimum compare to other mapping.
Disadvantage : If a program requires block0 and block128 repeatedly then cache miss will occur due to block0 and block128 are mapped in the same place in cache.

Associative Mapping





Advantage : There is no limitation in block mapping.

Disadvantage : Search space is maximum compare to other mapping.

2 Way Set-Associative Mapping

Main memory size = 64 KB

Cache memory size = 2 KB

Block size = 16 B = 2^4

No. of way =2

No. of block present in cache=128

No. of set present in cache

$$= \frac{\text{No. of blocks present in cache}}{\text{No of way}}$$

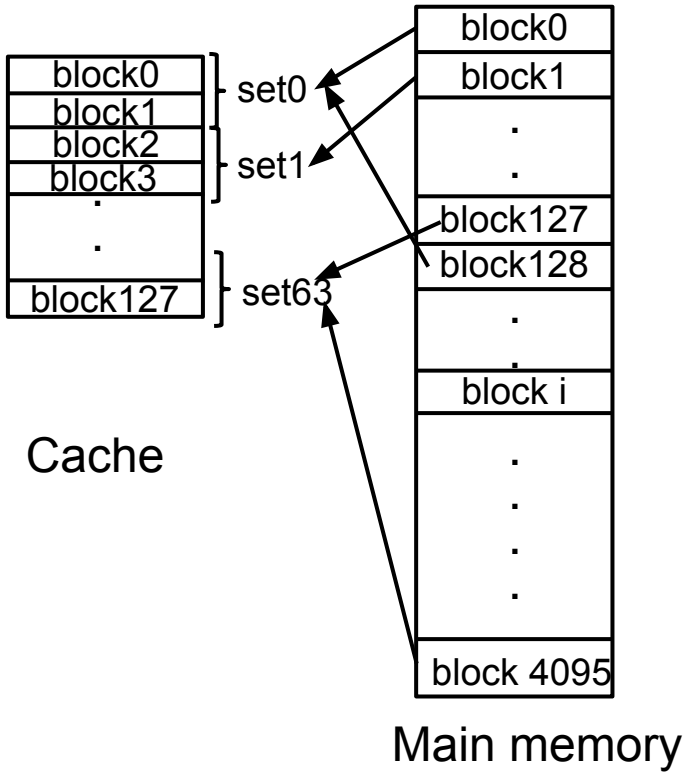
$=128/2=64 = 2^6$

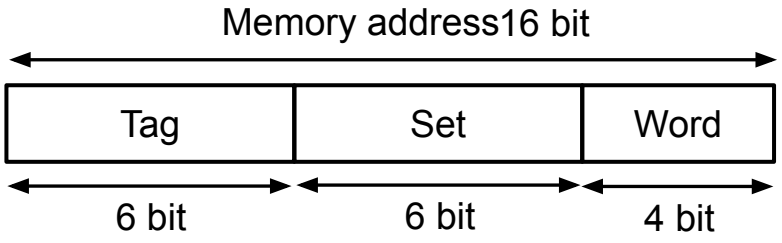
No. of Tags present

$$= \frac{\text{main memory size}}{\frac{\text{cache memory size}}{\text{No of way}}}$$

$$= \frac{2^6 \times 2^{10} \times 2}{2 \times 2^{10}}$$

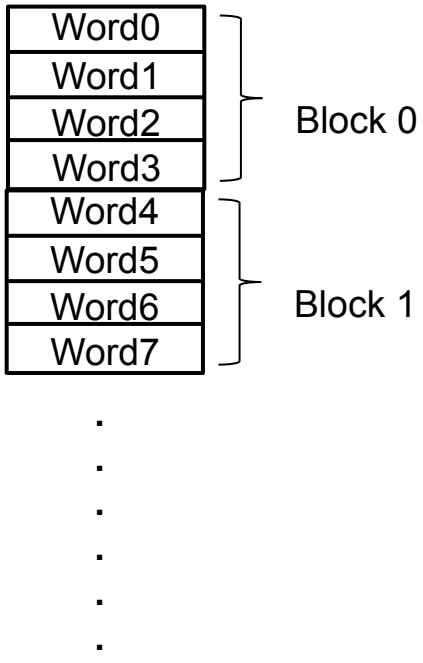
$= 2^6$





Thank You

Block size is 4 byte



Back